盛岡高等農林學校
學術報告
第九號

THE
BULLETIN
OF THE
IMPERIAL COLLEGE OF AGRICULTURE
AND FORESTRY
MORIOKA,
JAPAN

No. IX.

On a New Species of *Alternaria* Causing a Leafspot Disease of *Gomphrena Globosa* L.
Notes on Some Parasitic Fungi of Japan.

KOGO TOGASHI

大正十五年五月
MORIOKA, MAY, 1926.

盛岡高等農林學校

學術報告

第九號

THE BULLETIN

OF THE

IMPERIAL COLLEGE OF AGRICULTURE AND FORESTRY

MORIOKA,

JAPAN

No. IX.

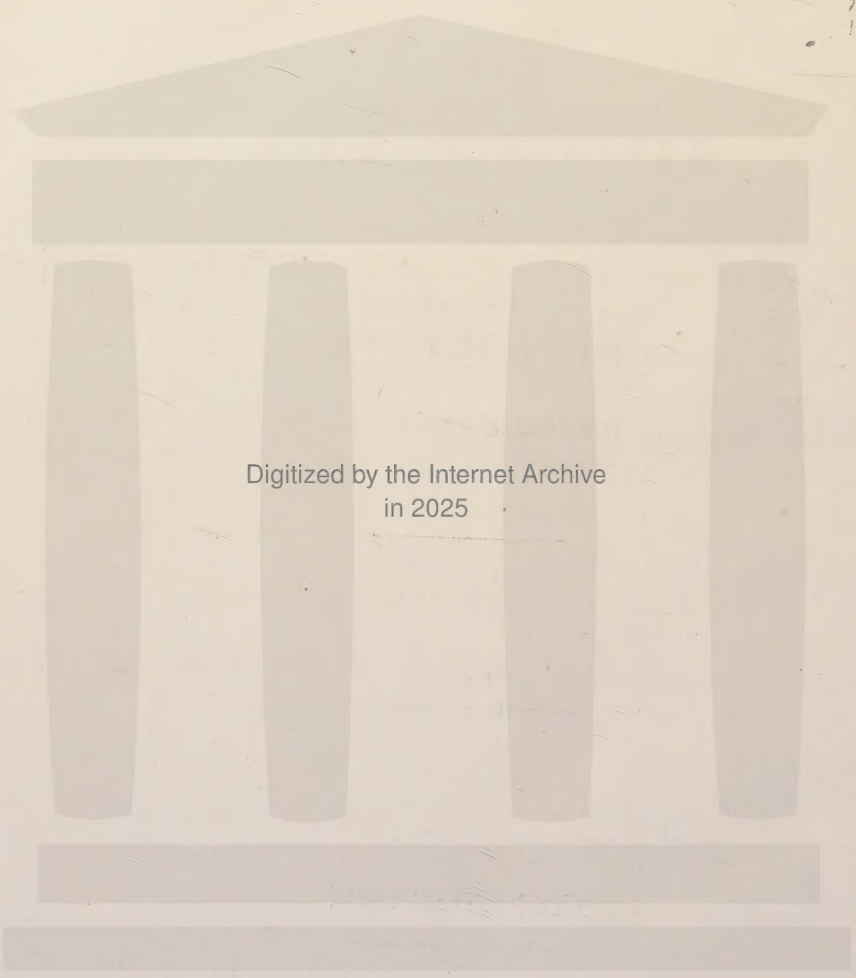
ON A NEW SPECIES OF *ALTERNARIA* CAUSING A LEAFSPOT DISEASE OF *GOMPHRENA GLOBOSA* L.

NOTES ON SOME PARASITIC FUNGI OF JAPAN.

KOGO TOGASHI

大正十五年五月

MORIOKA, MAY, 1926.



ON A NEW SPECIES OF *ALTERNARIA* CAUSING A LEAFSPOT DISEASE OF *GOMPHRENA GLOBOSA* L.*

BY

KOGO TOGASHI.

In the middle of August, 1924, the writer's attention was called to a peculiar leafspot disease of *Gomphrena globosa* L. (Amaranthaceae) in the vicinity of Kyoto. The disease was causing considerable damage and in some cases was so extensive as entirely to kill the leaf.

After studying the cause carefully, the writer has come to the conclusion that the disease is caused by an undescribed fungus belonging to the genus *Alternaria*.

Symptoms of the Affected Plants

The disease usually appears on the leaves about the middle of the growing season, mostly on the lower and middle leaves. The first noticeable evidence of it is a dark reddish purple speck of the size of pin head. These minute specks enlarge gradually up to a maximum of about 8 mm. in diameter. The spot is roundish with a conspicuous border which surrounds pale and dried portions. The innerside of the border is Hay's maroon (Ridgway, Pl. XIII)[1] in color and the outerside is acojon red (Ridgway, Pl. XIII). It is pinkish buff (Ridgway, Pl. XXIX) in the dried portion, the inside of which is pale smoke gray (Ridgway, Pl. XLVI) in

* Contributions from the Laboratories of Phytopathology and Mycology, Kyoto Imperial University, Kyoto, Japan. No. 1.

1) Roman numerals refer to the plates in Ridgway's "Color Standards and Nomenclature".

Fig. 1. Leaves of *Gomphrena globosa* affected by *Alternaria Gomphrenae*.

color. Then the dried part of the spot becomes sparsely covered with hyphal bodies of the color of chaetura drab (Ridgway, Pl. XLVI) or frequently with obscure concentric rings of the same color. The spots are sometimes coalescent and finally the diseased leaves wither early in the season. In late summer, when the normally growing host plants are thriving, it is not rare to find affected plants with brown shriveled leaves clinging to the stem and branches.

Morphology

The conidiophores (Fig. 2, a, b) are amphigenous, mostly epiphyllous, arising singly or in bunches of 3 or 4, often of from 5 to 9, from the stomatal openings. In most cases they are simple, rarely branched, brown in color and lighter

towards the tip. They measure from 65 to 123 μ long with a width of from 5 to 8 μ and are from 1 to 5 septate. In general, the conidia are singly borne on the tips of the conidiophores, but in a very few cases 2 or 3 conidia are found in a chain. Tney are elongate-obclavate to obclavate in shape, terminating in long septate beaks, often curved and

Fig. 2. a, b. Conidiophores. c. Conidia produced on the natural host. d, e, f. Conidia formed on various culture media. d. On corn meal agar medium. e. On banana decoction agar medium. f. On apricot decoction medimm. (×450).

somewhat constricted at the septa, but sometimes not (Fig. 2, c). The color of the conidia is brown, lighter in the beaks, and the walls of them are smooth. The conidia have 5–14 transverse septa, while the longitudinal ones are mostly lacking. Out of 500 individuals observed, conidia with one longitudinal septum numbered 28, those with two septa, 2 and those with three, also 2, these together being 6.4 per

cent of the total number examined. It is an interesting fact that the occurrence of the longitudinal septation is limited to the medium-sized individuals and to the ones which have the transverse septa in moderation; that is, it occurs in conidia 76–164 μ in length (extremes, 56–216 μ) and having between 8 and 12 transverse septa (extremes, 5–14).

As we already know in many cases of fungi, the shape and size of the conidia of our fungus vary conspicuously with the environmental facfors under which they are produced. The conidia measured on August 24, it having rained all the previous night, were remarkably longer (mean, 144.44±2.53 μ) than those observed on August 17 (mean, 112,99±1.62 μ) and 19 (mean, 114.22±1.59 μ). In Table I we can see these differences in detail. According to the results of the measurements obtained during these 3 days, the extreme dimensions of the conidia are 56-216 μ in length with a mean value of 126.06±0.87 μ, and 11–20 μ in width with a mean value of 14.21±0.065 μ.

TABLE I.

LENGTH AND WIDTH OF CONIDIA FORMED ON HOST.

	Date collected	Mean	Mode	Standard deviation	Max.	Min.	Number measured
Length (in μ)	Aug. 17	112.99±1.62	126	±22.27	180	56	189
	Aug. 19	114.22±1.59	124	±21.04	172	56	175
	Aug. 24	144.44±2.53	128	±29.51	216	80	136
	Total	126.06±0.87	124	±19.67	216	56	500
Width (in μ)	Aug. 17		15		20	11	189
	Aug. 19		14		19	11	175
	Aug. 24		15		18	11	136
	Total	14.21±0.065	15	±1.46	20	11	500

Taxonomy and Description

The genera *Alternaria* and *Macrosporium* are very closely related in many respects and the distinction between these two genera principally depends upon the catenation of coni-

dia, which is characteristic of the former genus. The genus *Alternaria* was first described in 1817 by Nees (7) and the genus *Macrosporium* by Fries (4) in 1832. However, Bolle (2) recently asserted that Fries' *M. tenuissimum* and *M. caricinum* should be transferred to the genus *Sporidesmium* (=*Clasterosporium* Schweinitz) which was created by Lind (6) in 1809. The remaining two species of Fries, *M. Convallariae* and *M. Cheiranthi* were placed in *Alternaria* by Elliott (3) and Bolle (2) after they had studied the exsiccati independently. Consequently, the genus *Macrosporium* should dropped altogether, but Bolle (2) retains this familiar genus with the type of *M. sarcinula* which was described by Berkeley (1) in 1838 and she emends this genus.

As far as the writer knows, nothing has been recorded concerning the occurrence of *Alternaria* or *Macrosporium* on the host of our fungus, *Gomphrena globosa*. However, considering the members of Amarantaceae to which family our host plant belongs, there are some reports that *A. tenuis* Nees and *M. Amarantis* Peck occur on *Amarantus retroflexus* L. and also that *M. Celosiae* F. Tassi occurs on *Celosia cristata* L. Elliott (3) divided the species of *Alternaria* and *Macrosporium* into 7 groups based on the difference in the shape and size of their conidia. According to his division, *A. tenuis* is placed in the *A. tenuis* group (conidia quite variable in form as well as in size, generally broad, muriform, 11–50×7–20 μ), *M. Amarantis* is a member of the *A. Brassicae* group (conidia regular, oblong, tapering, acute-beaked, a few longitudinally septate, 35–120×10–30 μ). *M. Celosiae* was not studied by him but perhaps it may be placed in the *A. tenuis* group, judging from the descriptions given by Saccardo (12) and Lindau (5). The conidia of our fungus are longer than those of the *A. Brassicae* group and they are more slender than those of the *A. herculeum* group, which are the largest among the groups.

Again, Elliott's trial inoculation experiments prove that an *Alternaria* or a *Macrosporium* is capable of affecting

various species of the same genus, often even the members of different genera belonging to the same family, while they have no power to infect species of different family. Bolle (2) also obtained the same results from his inoculation experiments on some species of *Alternaria*.

From the above stated facts, the writer wishes to treat our fungus as a new species, proposing for it the name, *Alternaria Gomphrenae*. Its description as follows:—

Alternaria Gomphrenae sp. nov.

Foliicolous, spots large, up to 8 mm. in diameter, circular or subcircular, with a dark reddish purple border, paled and dried in center, later sparsely covered by blackish hyphal bodies, sometimes with an appearance of obscure zonation, often coalescent, and covering a greater part of the surface.

Conidiophores amphigenous, mostly epiphyllous, arising singly or in bunches of 3–4, often of 5–9, simple, rarely branched, brown, lighter towards the tip, 65–123×5–8 μ in size, 1-5 septate, generally bearing a single conidium at the apex, and rarely 2-3 in a chain; conidia elongate-obclavate to obclavate in shape, terminating in long septate beak, often curved, somewhat constricted at the septum, but sometimes not, brown, lighter in beak, smooth, 5–14 transversely septate, with a few longitudinal septa, and 56–216×11–20 μ in size.

Hab. On the living leaves of *Gomphrena globosa* L.

Pref. Yamashiro, Kyoto (Aug. 7, 1924, T. Hemmi, K. Togashi; Aug. 14, 1924, T. Nojima; Aug. 17, 1924, K. Togashi; Aug. 19, 1924, K. Togashi; Aug. 24, 1924, K. Togashi; Aug. 27, 1924, T. Hemmi; June 22, 1925, K. Togashi; Aug. 5, 1925, K. Togashi; Aug. 10, 1925, K. Togashi; Dec. 4, 1925, K. Togashi).

Germination and Conidium Formation

Up to the present time various investigators have proposed several methods of isolating single spores of fungi.

In the course of this experiment, the writer found that such large spores as those of *Alternaria* are quite easily isolated by the following method:—

The conidia that have formed on the leafspot are scraped off and scattered over a sterilized clean glass slide with a sterilized needle or scalpel. They are selected under a microscope and picked up by means of a sterilized moistened tapering glass-rod which at the end has a glass-ball of approximately 0.5 mm. in diameter. This metnod is very simple and extremely convenient for withdrawing a conidium because it is so dry under natural conditions that it soon attaches itself to a little water on the surface of a glass-ball. Later on, the writer found that it was better to use a slender platinum needle instead of the tapering glass-rod for withdrawing the conidia the operation being aided by the mechanical agitation. Then the conidium is readily removed to the desired medium. After using, the instrument is sterilized in any appropriate manner and re-used as often as necessary.

Two methods were employed to observe conidium germination, the drop culture and the nutrient agar film method. The cover glass containing a single conidium was inverted over a Van Tieghem cell and kept in a moist condition for several days. The agar film method is the more desirable for a study of the germinating process, offering as it does the advantage of keeping the conidium stationary.

The germination occurs within 3 hours at summer room temperature (about 30°C). It starts at both ends of the conidium or irregularly at the sides (Fig. 3, a, b). Roberts (11), who has studied the morphological characters of *Alternaria Mali* Roberts considers the distal end or the beak of the conidium of *Alternaria* as a conidiophore, judging from the results of his experiments that the end spore in a chain which does not start conidium budding has no isthmum, or has no especially long one, also that the isthmum is incapable of germination, etc. In our case, however, it was most common for the germination to start from the distal end as

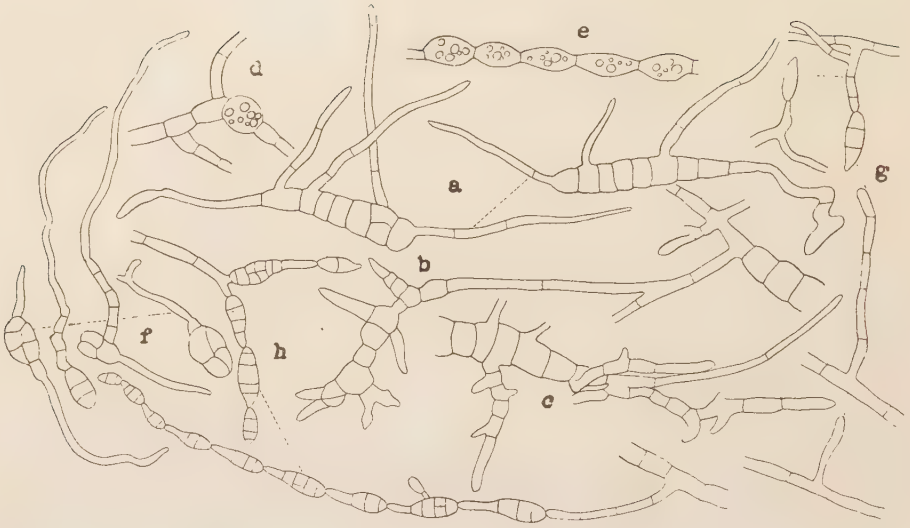


Fig. 3. a, b, c. Germination of conidia formed on the natural host. d, e. Vesicular highly vacuolate thin-walled bodies produced on the germ tube.
f. Germination of conidia formed on culture media.
g, h. Showing conidium formation. (×450).

well as from the basal end (Fig. 3, a) and this fact was evident even in the germinating process of conidia produced on the culture media (Fig. 3, f). Considering the above mentioned data, we can't agree with Roberts' opinion and we shall retain the distal end under the term beak or isthmum in the sense of a part of a conidium, as many investigators consider. In our fungus, usually from 4 to 5 germ tubes, rarely as many as 9 germ tubes push out from a conidium starting from different cells, but in some cases 2 (rarely 3) germ tubes occur from a single cell. Generally, the germ tubes are 4–8 μ in width, soon become septate and branch. The mycelium contains many fatty globular substances in it and with age turns grayish orange. Between the hyphae, anastomosis is rather frequently observed. Osner (8) in his study of *Stemphylium cucurbitacearum* Osner has reported that vesicular highly vacuolate thin-walled bodies are sometimes produced on the germ tube. The writer also found such bodies (Fig. 3, d) formed on the tip of the germ tube,

although they were not so conspicuous as Osner represented them in his text. These bodies again germinate and often make a chain by successive formation (Fig. 3, e). In some instances the cells of a germ tube enlarge, become tickly septate and branch densely at its end (Fig. 3, b). The latter phenomenon appears more frequently when saccharose solution is being used as a medium, and the former in the case of glucose medium, which is less suitable for the growth of the germ tubes. But these phenomena probably have no important significance in the life history of this fungus.

Tne conidiophore begins as an outgrowth of a mycelium hardly distinguishable from the vegetative hypha. It is at first hyaline, later colored, septate as growth proceeds and somewhat lighter in color or colorless towards the tip, at which place the cell enlarges and a septum is soon laid down between the conidiophore and the conidium. The conidium is produced about 36 hours after sowing. It is at first colorless and one-celled but with age it become colored and following this the transverse and longitudinal septations occur. In the nutrient media even in distilled water, the conidia are successively produced forming a chain and a single chain made of 9 conidia is sometimes observed. The conidiophore often branches and also some cells of the beak as well as of the conidium put out an outgrowth and produce conidia at the apex (Fig. 3, h).

Cultural Characters

With a single conidium of this fungus, a pure culture was started at the room temperature, of which the maximum was 31°C and the minimum, 24.5°C during the course of the experiment. The mycelial growth and the conidium formation were more or less different according to the media used. The characters on some of these media are as follows :—

On oat meal agar medium. The mycelial growth was very vigorous. On the tenth day after inoculation, the mycelia

covered the whole surface of the medium in Petri dish with a thick carpet-like growth. Its color was whitish on the margin, smoke gray (Ridgway, Pl. XLVI) in the center and a few broad zonations appeared. Even after one month, no conidia had been produced on this medium.

On corn meal agar medium. Appearance nearly the same as on the oat meal medium except deeper in color. It was citrine-drab (Ridgway, Pl. XL) with dark olive (Ridgway, Pl. XL) zones producing conidia abundantly.

On banana decoction agar medium. In this case, the mycelial growth as well as the conidium production was most vigorous and the hyphal layer showed a thick carpet-like appearance. It was smoke gray (Ridgway, Pl. XLVI) to deep grayish olive (Ridgway, Pl. XLVI) in color with two or three broad zones along which the white aerial mycelia grew.

On apricot decoction agar medium. Resembling the last medium it was olivaceous black (2) (Ridgway, Pl. XLVII) round the margin and light grayish olive (Ridgway, Pl. XLVI) or dark olive-buff (Ridgway, Pl. XL) in the center. The conidium production was also abundant.

On the agar medium of a leaf decoction of *Gomphrena globosa*. The mycelial growth was scanty with a broad zonation of more or less flocculent white aerial mycelia and no conidia were produced.

A great many experiments with cultures of *Alternaria* and *Macrosporium*, have been carried out by Elliott (3), Bolle (2), etc. From their results, we learn that the size and shape of these conidia vary in some degree with the media used as well as with the conditions under which they grow. In our case, the variations between the conidia produced on the natural host and on the culture media are so remarkable that we can't consider the latter to originate from the former. The mean value of the length of the conidia on the natural host is more than five times that in the cultural media, although the difference in width is not conspicuously notable.

These facts will be seen in detail if the data relating to conidium measurements in Tables I and II are compared.

The conidia in culture (Fig. 2, d, e, f) have 1–8 transverse septa, and 0–4 longitudinal ones, generally 3–4. The longitudinally septate conidia number 298 out of 500 conidia examined, or 59.6 per cent. When we compare this with the case in the natural host we will see that it is more than nine times the latter. The conidia produced in the culture media are extremely variable in shape, being obclavate, ellipsoidal, ovate or in extreme cases subgloboid, with a short beak or without one. In most cases, these conidia are constricted at the septa, deeper in color than the natural ones and usually verrucose. The fact that in culture the smooth conidia of *Alternaria* often become verrucose has already been reported by some investigators. Roberts (11) in his study on *Alternaria Mali* states that "Verrucosity or absence of verrucosity was not so much a difference between conidia as between chains of conidia, the conidia of individual chains usually being all verrucose or all smooth-walled" and then in another part, he states "it is possible that environment is the sole reason for the variation in verrucosity". According to my examinations of the conidia in various artificial media, the verrucosity seems to be connected with the age of the conidium. If we examine the conidia in younger cultures, they are always pointless, but if we examine them one month or more later, we will find that they have become almost verrucose.

Elliott (3) observed what he terms "secondary development" of conidia on many species of *Alternaria* with a few exceptions and Weimer (13) noticed the same in the case of *Alternaria Brassicae:* this was also noticed by the writer. In the younger cultures the conidium is almost regular in shape and smooth with few longitudinal septa. As the conidium grows older the constrictions at the septa become deeper, the cells round off, the conidium becomes darker in color and the walls become roughened.

TABLE II

LENGTH AND WIDTH OF CONIDIA FORMED ON VARIOUS CULTURAL MEDIA

	Media used	Mean	Mode	Standard deviation	Max.	Min.	Number measured
Length (in μ)	Corn meal agar	30.56±0.53	24	±5.34	56	12	100
	Apricot agar	30.48±0.61	20	±6.11	44	12	100
	Banana agar	20.56±0.52	20	±5.24	36	12	100
	Saccharose (0.42%) agar	24.36±0.64	24	±6.40	60	16	100
	Glucose (0.24%) agar	23.64±0.62	24	±6.22	52	12	100
	Total	24.32±0.34	24	±7.79	60	12	500
Width (in μ)	Corn meal agar	9.07±0.15	8	±1.57	12	5	100
	Apricot agar	10.92±0.18	10	±1.80	18	8	100
	Banana agar	10.34±0.17	9	±1.71	17	7	100
	Saccharose (0.42%) agar	9.79±0.13	9	±1.33	12	7	100
	Glucose (0.24%) agar	10.12±0.15	10	±1.56	14	8	100
	Total	10.04±0.76	10	±1.71	18	5	500

Pathogenicity of the Fungus

During a period extending from the summer of 1924 to autumn of the next year, several inoculation experiments on the host plants were undertaken with the conidia produced on the culture media. But the results of these experiments were all negative and also the inoculation tests on *Amarantus retroflexus* L. and *Celotia cristata* L. which, like our host, belong to Amarantaceae had also negative results. With

conidia produced on the host plant in nature, however, the infection took place very easily showing the typical leafspot, and when the leaves were wounded with a sterilized needle, it resulted more easily. As an example, I will show the result of an inoculation experiment in the following table:—

TABLE III

RESULT OF INOCULATION EXPERIMENT ON THE HOST PLANTS
(TENTH DAY AFTER INOCULATION)

	With conidia produced on the host plant			With conidia produced on the culture media			Control		
	No. of pot	Drops of conidium suspension	Spots produced	No. of pot	Drops of conidium suspension	Spots produced	No. of pot	Drops of sterilized water	Spots produced
Without wound	1 (1)[1]	40	27	9 (1)	30	0	15 (1)	40	0
	2 (2)	37	25	10 (2)	35	0	16 (2)	45	0
	3 (2)	30	24	11 (2)	40	0			
	4 (1)	43	30						
With wounds	5 (3)	30	32[2]	12 (2)	30	2[3]	17 (2)	20	0
	6 (2)	35	37	13 (1)	35	0	18 (1)	35	0
	7 (1)	45	64	14 (2)	40	0			
	8 (1)	30	43						

1) The numbers in parentheses show the number of the host plants in each pot.
2) That the number of the spots formed is greater than that of the drops places on the leaves is due to the formation of 2 or 3 spots on the part occupied by one drop. When examined they were small as pin-heads but they enlarged gradually 2 or 3 often coalescing.
3) Two spots were formed on uninoculated parts of the leaves.

The conidium taken from the lesion produced naturally invades the host tissue on the first or second day. In most

cases, the germ tube or mycelium penetrates epidermal wall directly and the portion at which the hypha comes in contact with the surface cells is somewhat depressed and the hypha more or less swells up at the point of contact (Fig. 4, a, d).

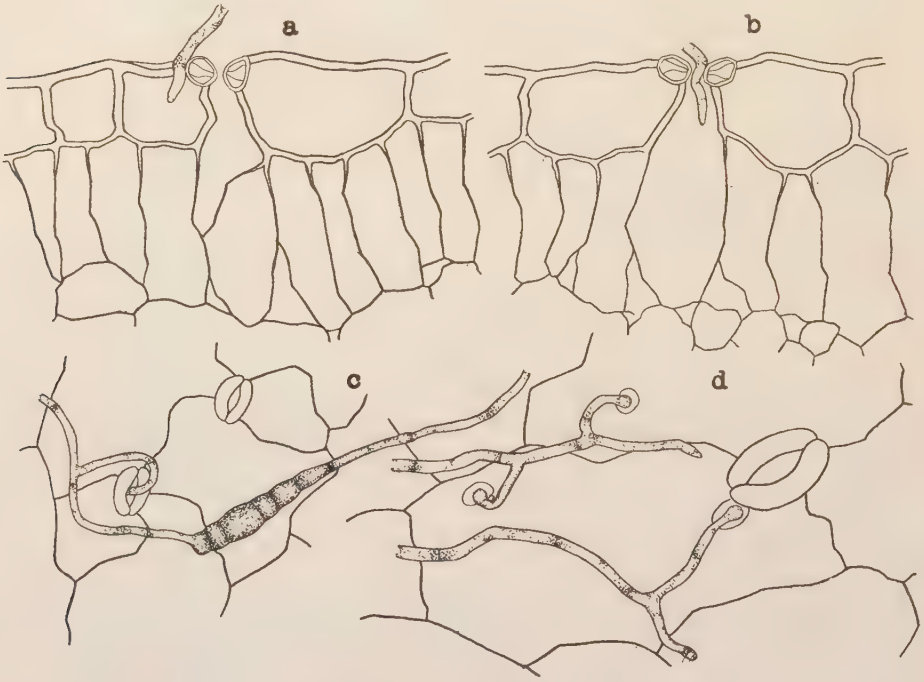


Fig. 4. a, d (×800). Showing penetration in epidermal cells. b, c. Showing penetration through stomatal opening. (×450).

Sometimes it was noticed that the hypha invaded the host through the stomatal opening (Fig. 4, b, c). But so called "peg-like" hyphae were not observed in course of penetration. Until now, no evidence of the penetration of the germ tubes of conidia produced on the culture media has been obtained even in when the experiments were carried on at the same time as parallel experiments with those on the natural host.

Consequently, the question arises why the conidium produced on the culture media has no power to infect the host plant and then whether another organism or other

pathogenes besides our fungus are not connected with the leafspot disease. In the course of my isolation experiments, a milk white colony of bacterium, a salmon red colony of yeast and a hyphal colony of *Cladosporium* sp. as well as the hyphal colony of our fungus appeared on some cultural media. With the pure culture of these organisms, inoculation tests on the host plants were repeatedly undertaken but all these experiments had also negative results. When a small piece of the lesion was cut out after sterilizing the diseased leaves with corrosive sublimate and the pieces were placed on various media, only the hyphae of our fungus could be constantly isolated.

From the above experimental data, it may be safely inferred that *Alternaria Gomphrenae* is the cause of the leafspot disease of *Gomphrena globosa*.

Summary

1. In the vicinity of Kyoto, the leaves of *Gomphrena globosa* L. were seriously damaged by a species of *Alternaria* which had never before been reported.

2. After careful studies in taxonomy and morphology, the causal fungus was described under the name of *Alternaria Gomphrenae* n. sp.

3. At room temperature in summer the conidia germinated within three hours and new conidia were produced after thirty six hours, soon after forming spore chains.

4. The conidia formed on culture media were conspicuously smaller than and much different in shape from those produced under natural conditions.

5. The conidia produced on the culture media could not affect the natural hosts but the conidia taken directly from the diseased leaves quite easily infected them.

6. The germ tubes of the conidia on the natural host penetrated the epidermal walls directly and in rare case through the stomatal openings.

7. No evidence of penetration of the germ tubes of the conidia produced on the culture media has been observed by the writer.

December 21, 1925.

Laboratory of Phytopathology,
Department of Agriculture,
Kyoto Imperial University,
Kyoto, Japan.

Literature Cited

1) Berkeley, M. J. :—Notices of British Fungi (Ann. Nat. Hist. Mag. Bot. and Geol. I, 1838, p. 261).
2) Bolle, P. C. :—Die durch Schwärzepilze (Phaeodictyae) erzeugten Pflanzenkrankheiten. (Mededeelingen uit het Phytopathologisch Laboratorium „ Willie Commelin Scholten " VII, 1924, S. 1–77, Tafel I–III).
3) Elliott, J. A. :—Taxonomic Characters of the Genera *Alternaria* and *Macrosporium*. (Amer. Journ. Bot. IV, 1917, pp. 439–476, Pl. XIX–XX).
4) Fries, E. M. :—Systema Mycologicum III, Pt. 2, 1832, p. 372.
5) Lindau, G. :—(Rabenhorst's Krypt. Fl. Aug. II, Bd. 1, Abt. IX, 1910, S. 236.
6) Link, H. F. :—Observations in Ordines Plantarum Naturales. (Mag. d. Ges. Naturf. Freunde, Berlin III, 1809, pp. 3–42).
7) Nees, v. Esenbeck, Chr. G. :—System der Pilze und Schwämme, Würzberg II, 1817, p. 72).
8) Osner, G. A. :—Stemphylium Leafspot of Cucumbers. (Journ. Agr. Research XIII, 1918, pp. 295–306, Pl. 21–24, Fig. 1–3).
9) Peck, C. H. :—New Species of Fungi. (Bull. Torrey Bot. Club XXII, 1895, p. 493).
10) Roberts, J. W. :—Experiments with apple Leaf-spot Fungi. (Journ. Agr. Research II, 1914, pp. 57–66, Pl. VII).
11) Roberts, J. W. :—Morphological Characters of *Alternaria mali* Roberts. (Journ. Agr. Research XXVII, 1924, pp. 699–708, Pl. I–II, Fig. 1).
12) Saccardo, P. A. :—(Sylloge Fungorum XVIII, 1906, p. 619).
13) Weimer, J. L. :—*Alternaria* Leafspot and Brownrot of Cauliflower. (Journ. Agr. Research XXIX, 1924, pp. 421–441, Pl. I–IV, Fig. 1–3).

NOTES ON SOME PARASITIC FUNGI OF JAPAN*

BY

KOGO TOGASHI

1. *Bremia graminicola* Naoumoff in Bull. Soc. Mycol. France XXIX, p. 275, pl. XIII, figs. 1–3, 1913.—Miyake, Bot. Mag. Tokyo XXVIII, p. 37, pl. I, figs. 1–3, 1914.

Hab. On *Arthraxon ciliaris* Beauv. (Kobunagusa).

Kyoto: Sept. 14, 1924, T. Abe.

The present fungus was first found by N. Naoumoff in the vicinity of Vladivostok, Russia and described by him in 1913. In 1914 I. Miyake recorded that he had found the same fungus parasitic on the same plant in China. Our fungus has longer conidiophores as well as somewhat larger conidia than those of the original description, but we can easily recognize the coincidence of their essential characters. According to Miyake, the conidiophores of his fungus are conspicuously shorter, while the conidia are larger than those of our fungus. The general characters[1] of our fungus are as follows:—

Spots large, being limited by the veins, first yellowish, then brownish in color, later occupying the whole surface of the leaf and at last the leaves shrivelled; conidiophores hypophyllous, rarely epiphyllous, cespiticious, flocculose, first whitish, then greyish in color, generally 460–760 μ in length, often up to 825 μ long, 7.5–10.0 μ in diameter, with somewhat swollen base, measuring 13–15 μ in diameter and 5–6 times

* Contributions from the Laboratories of Phytopathology and Mycology, Kyoto Imperial University, Kyoto, Japan. No. 2.

1) The writer owes a debt to Mr. T. Abe for the measurements of conidiophores and conidia.

dichotomously branched, branches of conidiophores more or less recurved, making inflated swollen ends, with 4–5 papillae; conidia globoid or subgloboid, slightly papillated at the apex, hyaline and 11-15 μ in diameter.

2. *Phyllachora Pogonatheri* Syd. in Annal. Mycol. XIII, p. 40, 1915.—Theiss. et Syd., Annal. Mycol. XIII, p. 458, 1915.

Hab. On *Pogonatherum sacharoideum* Beauv. (Itachigaya).

Pref. Kagoshima: Taniyama, July 27, 1924, T. Nojima.

Japanese literature[1)2)] *Phyllachora Cynodontis* (Sacc.) Niessl is noted as a parasite of this host plant. But our fungus is nothing but *Phyllachora Pogonatheri*. The results of my investigation are as follows:—

Stromata amphigenous, scattered, solitary, roundish, black, 1/4–1/2 mm. in diameter, each penetrating the leaf and prominate on both sides; perithecia applanate, 1–3 in a stroma, showing thick (about 25 μ) clypeus bilaterally 322–308 μ wide and 160–198 μ high; asci cylindrical or elongate-clavate, short-stipitate, 8-spored, paraphysate and 60–96 × 10–14 μ; spores obliquely uniseriate, often biseriate, ellipsoidal or ovoidal, one-celled, hyaline and 10.8–14.0 × 6.0–7.2 μ.

3. *Physalospora japonica* n. sp. Perithecia amphigenous, on pale brown unbordered spots, scattered or two or three crowded together, covered by the epidermis, buried in the parenchyma, papillate, erumpent with the ostiolum, membranaceous, olivaceous black, globose or globose-ovoid, 108–164 μ in diameter and 128–200 μ in height; asci clavate, often cylindrical, attenuated at the ends, short-stipitate, hyaline, 60–84 × 7–13 μ and 8-spored; ascospores biseriate, sometimes

1) Shirai, M. and Miyake, I. in Nihon Kinrui Mokuroku (A List of Japanese Fungi) p. 441, 1917.

2) Ideta, A. in Nihon Shokubutsu Byorigaku (Hand-Book of the Plant-Diseases of Japan) p. 251, 1909–1911.

obliquely uniseriate, fusiform or subfusiform with straight one side, continuous, glanular, hyaline and 15–22×5.0–7.4 μ in size; paraphyses abundant, filiform and longer than the asci.

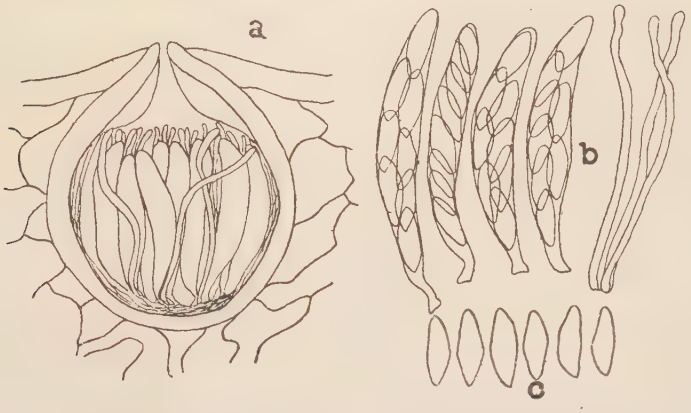


Fig. 1. a. Perithecium. b. Asci and paraphyses. c. Ascospores.

Hab. On *Thea japonica* Nois. (=*Camelia japonica* L.) (Tsubaki).

Pref. Kyoto: Kurama, June 14, 1924, K. Togashi.

As far as the writer knows, *Physalospora neglecta* Petch[1)2)] is the only species of *Physalospora* parasitic on the species of *Thea* and *Camelia*. But our fungus is easily distinguished from the above species by its exceedingly larger asci and ascospores.

4. *Puccinia Campanulae* Carmich. in Berk. Engl. Fl. V, p. 365, 1863.—Cooke, Handb. p. 498, 1871; Micr. Fung. p. 205, 1878.—Plowright, Ured. p. 200, 1889.—Sacc. Syll. VII, p. 677, 1888.—Sydow, Monogr. Ured. I, p. 196, tab. XII, fig. 182, 1904.—Schröter, Pilze Schles. I, p. 344, 1889.—Winter, Pilze, p. 173, 1884.—Fischer, Ured. Schweiz p. 175, fig, 136, 1904.—Grove, Brit. Rust Fungi p. 159, fig. 111, 1913.

1) Saccardo, P. A. and Trotter, A. in Sacc. Syll. Fung, XXII, p. 81, 1913.
2) Höhnel, F. v. in Ann. Myc. XVI, p. 162, 1918.

Hab. On *Adenophora remotiflora* Miq. (=*Campanula remotiflora* Sieb. et Zucc.) (Sobana).

Pref. Tottori: Taisenji, III, July 1, 1924, K. Togashi.

The fungus in question is a new addition to the mycological flora of Japan and so far as we can ascertain, *Adenophora remotiflora* is a new host of this species. The general characters of our fungus are as follows:—

Teleutosori hypophyllous, rarely epiphyllous, often petiolicolous or caulicolous, scattered or gregarious in circular groups, up to 4 mm. in diameter, sometimes confluent, elongated on the petioles, stems and the nerves of the leaf, covered for a long time by the epidermis which afterwards ruptured, surrounded by the remains and ferruginous-brown in color: teleutospores ellipsoidal, oblong or fusiform, with a thickened papilla above (7–12 μ), more or less constricted at the septum, rounded or somewhat attenuated below, smooth, pale-brown and 28–42 × 12–18 μ in size; pedicels hyaline, deciduous, as long as the spores or somewhat shorter and 4–8 μ in width.

5. *Puccinia ferruginea* Lév. in Apud Vaillant, Voyage de la Bonite, Fungi p. 204, tab. 140, fig. 5, 1839–1846.—Sydow, Monogr. Ured. I, p. 634, tab. XXXVI, fig. 484, 1904.

Syn.: *Puccinia Smilacis-Chinae* P. Henn. in Hedw XL, p. 125, 1901.—Sydow, Monogr. Ured. I, p. 635, tab. XXXVI, fig. 485, 1904.—Dietel, Annal. Mycol. VIII, p. 305, 1910.

Hab. On *Smilax China* L. (Sarutori-ibara).

Pref. Kagoshima: Taniyama, III, July 27, 1624, T. Nojima.

In 1901 P. Hennings described a *Puccinia* on *Smilax China* which was collected by T. Yoshinaga at Kamomura, Prov. Tosa under the name of *Puccinia Smilacis-Chinae*. Through the collector's courtesy I had an opportunity to examine the type specimen of this fungus carefully. After I had compared it with our fungus collected by Mr. T. Nojima, I came to the conclusion that *Puccinia Smilacis-*

Chinae coincides exactly with *Puccinia ferruginea* Lév. The sori of our fungus are hypophyllous, scattered or aggregated with an appearance of more or less circular deposit, verruciform, compact, ochreous brown or chocolate brown and measuring 1/3–1 1/2 mm. in diameter. When the smaller and younger sori of the fungus are examined, the teleutospores are mostly lighter colored or subhyaline and somewhat roundish in shape. They measure 40–64 μ in length and 20–32 μ in width. Their pedicels are hyaline or subhyaline, measuring 16–32 μ in width and up to 120 μ in length. These characteristics agree very well with the descriptions and the figures of *Puccinia Smilacis-Chinae* given by Hennings and Sydow. However, when we examine the larger and matured sori, we can easily find that teleutospores are yellowish brown in color and somewhat long shaped, measuring 40–80 μ in length and 16–32 μ in width. Their pedicels are subhyaline or yellowish brown as in the case of the spores and often

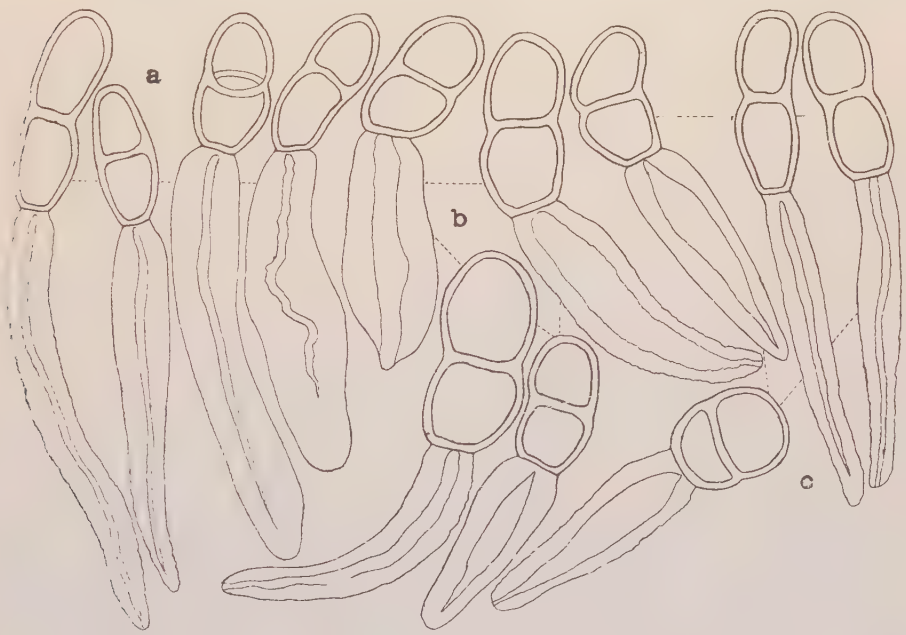


Fig. 2. *Puccinia ferruginea* Lév. a. Teleutospores in the matured sori. b. Teleutospores in the young sori. c. Teleutospores from the type specimen of *Puccinia Smilacis-Chinae* Syd.

darker at the base, measuring 12–32 μ wide and up to 168 μ long. These characteristics coincide these of *Puccinia ferruginea*. In the same sorus the former type of teleutospore is generally mixed.

From these facts, it may be safely inferred that *Puccinia Smilacis-Chinae* P. Henn. is a synonym of *Puccinia ferruginea* Lév. As another host plant of *Puccinia ferruginea*, I will mention *Smilax herbacea* L. var. *nipponica* Maxim. which was announced by Dietel as a host of *Puccinia Smilacis-Chinae*. Through the kindness of Mr. Yoshinaga, I have examined the fungus in question on this plant and easily found it to be the same as that on *Smilax China*.

6. *Puccinia melanoplaca* Syd. in Annal. Mycol. VII, p. 168, 1909.—Sacc. Syll. Fung. XXI, p. 657, 1912.

Syn.: *Puccinia Patriniae-gibbosae* Miura Sydow in Annal. Mycol. XI, p. 100, 1913.—Sacc. Syll. Fung. XXIII, p. 782, 1925.

Hab. On *Patrinia triloba* Matsum. (Kinreikwa).

Pref. Shizuoka: Mt. Fuji, III, July 31, 1924, I. Hayashi.

In 1909 H. and P. Sydow described *Puccinia melanoplaca* Syd. as parasitic on *Patrinia triloba* Matsum. (=*Patrinia palmata* Maxim.) basing on the specimen collected by I. Miyake at Mt. Kurohime, Prov. Shinano in Japan. In 1913 the same authors reported a *Puccinia* on *Patrinia gibbosa* Maxim. under the name of *Puccinia Patriniae-gibbosae* Miura, which was collected by M. Miura at Mt. Iwaki, Prov. Mutsu in Japan. After the description of the last species, they gave the following remarks; „Die Art steht der *Puccinia melanoplaca* Syd. nahe, unterscheidet sich aber durch hellere, nicht so gedrängt stehende Lager, sowie am Scheitel abgerundete, weniger verdickte Teleutosporen und das Vorkommen von Mesosporen". According to them *Puccinia melanoplaca* has no mesospores and this fact was recognized by them as one of the essential characters to distinguish it from *Puccinia Patriniae-gibbosae*. But I have found them certainly in our specimen.

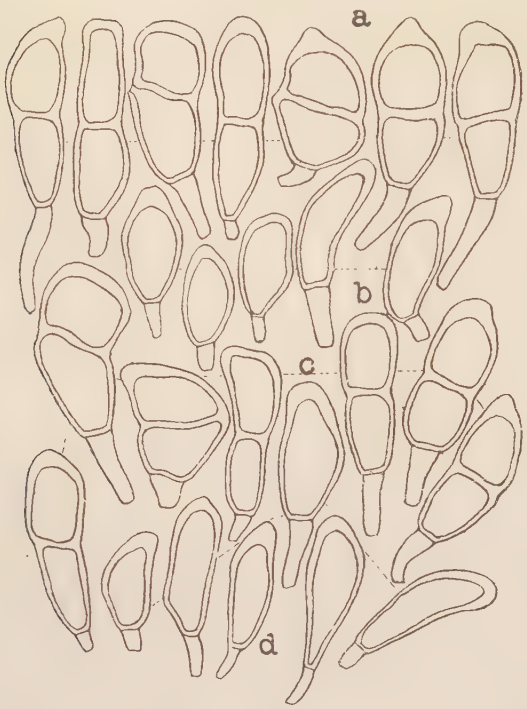


Fig. 3. *Puccinia melanoplaca* Syd. a. Teleutospores on *Patrinia triloba*. b. Mesospores on the same host. c. Teloutospores on *Patrinia gibbosa*. d. Mesospores on the latter host.

		Puccinia on *P. triloba*	*Puccinia* on *P. gibbosa*[1]
Aggregated sori	Sydow ...	2–8 mm. in diam.	3–6 mm. in diam.
	Togashi ...	1–7 mm. in diam.	1–6 mm. in diam.
Teleutospores	Sydow ...	35–52×15–25 μ. apex: up to 9 μ.	32–52×16–28 μ. apex: up to 5 μ.
	Togashi ...	32–60×15–28 μ. apex: 4–8 μ.	38–62×15–30 μ. apex: 3–8 μ.
Mesospores	Sydow ...	not find	25–35×14–18 μ.
	Togashi ...	26–42×15–20 μ.	24–42×15–20 μ.

As seen in the above table we may easily recognize that there are not only remarkable difference in the essential measurements, but also in the shape of their teleutospores

1) This specimen was collected by the writer at Mt. Komagatake, Prov. Oshima in July, 1920.

and mesospores, and in the appearance of their aggregated sori. From the morphological characters mentioned above, we may safely infer that these two forms of *Puccinia* are the same species showing a little difference to their host plant.

7. *Puccinia Poarum* Niels. in Bot. Todsskr. II, p. 26, 1876.—Sydow, Monogr. Ured. I, p. 795, 1904.—Fischer, Ured. Schweiz, pp. 361, 556, fig. 263, 1904.—Grove, Brit. Rust Fungi, p. 278, 1913.

Hab. On *Deschampsia flexuosa* Trin. (Kome-susuki).

Pref. Tottori: Taisenji, II, III, July 2, 1924, T. Abe.

So far as we can ascertain, *Deschampsia flexuosa* is a new host for this fungus.

In 1910 Arthur[1] described *Puccinia Deschampsiae,* found on *Deschampsia caespitosa* (L.) Beauv. In 1920 the same author[2] revised his opinion and transfered this species to *Dicaeoma epiphyllum* (L.) Kuntze, which corresponds fairly well to *Puccinia Poarum* Niels. In 1909 Ito[3] reported that a species of *Puccinia* found on *Deschampsia caespitosa*, which was introduced into Sapporo by seeds from Dublany, resembles *Puccinoa Poarum* more closely than other species of *Puccinia* parasitic on *Aira* (*Deschampsia*). He therefore treated the fungus provisionally under the above name. Our fungus on *Deschampsia flexuosa* agrees in its general characters exactly with the descriptions of *Puccinia Poarum* given by Sydow, Fischer and others.

8. *Uromyces Lespedezae-procumbentis* (Schw.) Curt. in Cat. Pl. N. Cor. p. 123, 1867.—Arthur, Journ. Mycol. X, p. 14, 1904.—Ito, Journ. Coll. Agr. Hokkaido Imp. Univ. XI, pt. 4, p. 224, pl. VII, figs. 10–14, 1922.

Hab. On *Lespedeza bicolor* Turcz. (Hagi).

Pref. Tottori: Hoki-taisen, I, July 1, 1924, K. Togashi.

---

1) Arthur, J. C. in Bull. Torrey Bot. Club XXXVII, p. 570, 1910.

2) Arthur, J. C. in North American Flora VII, pt. 4, p. 327, 1920.

3) Ito, S. in Journ. Coll. Agr. Tohoku Imp. Univ. III, pt. 2, p. 206, 1909.

The occurrence of the aecidial stage of this fungus seems to be very rare and this is the first record in our country. The morphological characters and the measurements of this stage agree exactly with those in the descriptions by Arthur and others.

9. *Phyllosticta Citrullina* Chester in Bull. Torrey Bot. Club XVIII, p. 373, 1891; Journ. Mycol. VII, p. 159, 1891.— Ellis and Everhart, North Amer. Phyllostictas p. 55, 1900.

Hab. On *Citrullus vulgaris* Schrad. (Suikwa).

Pref. Aichi: Anjo, June 25, 1924, K. Kuwatsuka.

In 1919 S. Yoshida[1] published a paper on a new black-spot disease of water-melons in Japan which was caused by a species of *Phyllosticta*. According to his description the conidia of his causal fungus are mostly ellipsoidal and rarely globoid or pyriform. They measure 2.5–8.0×2.0–4.5 μ. But the general characters of our fungus are as follows:—

Spots large, suborbicular or irregular, with concentric rings, dark brown and often confluent; pycnidia amphigenous, punctiform, brown, immersed, scarcely erumpent, membranaceous, lenticular and 87–140×52–87 μ; conidia cylindrical, rounded at both ends, generally continuous, sometimes uniseptate, straight or slightly curved, hyaline and 7.5–11.25× 2.5–4.0 μ.

10. *Macrophoma Commelinae* n. sp. Spots circular or subcircular, with a dark brown border, often coalescent, generally 2–6 mm. and rarely up to 12 mm. in diameter; pycnidia amphigenous, mostly epiphyllous, scattered, subepidermal, light brown in color, subglobose, 96–160 μ in diameter, 90–138 μ in height, ostiole distinct, and 12–24 μ across; conidia various in shape, cylindrical or elongate-ovoid, rounded at the ends, often curved, continuous, hyaline, 9–21.6 μ long and 3.6–5.4 μ wide.

1) Yoshida, S. In Byochugai-zasshi (Journ. Plant Protection) VI, No. 8, pp. 16–21, 1919.

Hab. On *Commelina communis* L. (Tsuyu-kusa).

Pref. Ibaragi: Tachihana, July 8, 1915, C. Akiyama; Tachihana, July 5, 1917, C. Akiyama. Pref. Fukuoka: Toyotsu-mura, Aug. 1, 1924, T. Nojima. Kyoto: June 29, 1925, T. Abe. Pref. Kyoto: Uji, Sept. 25, 1625, T. Abe.

The fungus in question differs from *Phyllosticta commelinicola* Young[1] which is reported on the leaves of *Commelina nudiflora* L. by the longer conidia, as well as by the nature of spots.

11. *Septoria Callistephi* Gloyer[2] in Phytopathology XI, p. 50, 1921.

Hab. On *Callistephus chinensis* Cass. (Yezo-giku).

Kyoto: June 17, 1924, T. Hemmi.

This fungus was first described in 1921 in America and the result of my investigation is as follows:—

Spots irregular, tawny colored and later confluent; pycnidia epiphyllous, scattered, innate, roundish or lenticular, membranous, 88–120 μ in diameter and 78–112 μ in height; conidia filiform, elongate-cylindrical, often tapering towards one end, hyaline, 0–3-septate and 23.4–43.2 × 1.2–1.8 μ in size.

12. *Septoria Centellae* Wint. in Grevillea XV, p. 92, 1887.—Sacc. Syll. Fung. X, p. 367, 1892.

Hab. On *Centella asiatica* Urb. (Tsubo-kusa).

Pref. Shimane: Saigo, July 6, 1924, K. Togashi. Pref. Kagoshima: Minato, July 28, 1924, T. Nojima.

The present fungus is also new to Japan. Its general characters are as follows:—

Spots circular or irregular, scattered or subgregarious, up to 5 mm. across, sometimes confluent, brownish, dry and pale or grayish in center, surrounded by an inconspicuous dark purple margin; pycnidia amphigenous, scattered, small,

1) Young, E. in Mycologia VII, p. 144, 1915.

2) Mr. H. Nakamura in our laboratory is now investigating on this fungus. A paper will be soon published.

erumpent, globose or subglobose, with an opening and 63–96 μ in diameter; conidia filiform, straight or curved, 0–3-septate, hyaline and 24–42 × 1.5–2.0 μ in size.

13. On *Cercospora Clerodendri* Miyake in Bot. Mag. Tokyo XXVIII, p. 53, pl. I, fig. 21, 1913.

Hab. On *Clerodendron trichotomum* Thunb. (Kusagi).

Kooto: Oct. 2, 1924, T. Nojima; Oct. 21, 1924, T. Hemmi, K. Togashi, K. Kawamura; Nov. 2, 1924, T. Abe.

In 1913 I. Miyake described this fungus, which he had found at Chiushi in China in 1908, under the above name. By comparing the characters of our fungus with his original description I found that they are undoutedly the same. But our fungus has slightly longer conidia (64–116 × 4–6 μ) as well as longer conidiophores (40–180 × 3–6 μ). From Mr. I. Miyake, received his opinion that he agree with my identification.

14. *Cercospora gnaphaliacea* Cooke in Journ. Linn Soc. XVII, p. 142, 1878.—Sacc. Syll. Fung. IV, p. 444, 1884.

Hab. On *Gnapharium multiceps* Wall. (Hahako-gusa).

Kyoto: June 5, 1924, T. Nojima; June 6, 1924, T. Nojima; June 7, 1924, T. Hemmi, K. Togashi; June 12, 1924, T. Hemmi.

This fungus is very common in the vicinity of Kyoto, but we have no other record of its occurrence in our country. Although the published descriptions of the above fungus as all somewhat incomplate, we can not recognize any distinct difference from the characters of our fungus. But the conidia of our fungus are more or less shorter and broader than those of the descriptions.

The general characters of our fungus are as follows:—

Spots dirty brown, showing a velvet-like appearance, irregularly roundish or elliptical, later coalescent and at length covering the whole surface of the leaf; conidiophores mostly epiphyllous, but often hypophyllous, cespitose, subflexuose, denticulate, simple or branched, 2 to 5-septate,

greyish brown and up to 180 μ long; conidia robustus, cylindrical, elongate-obclavate, 1–5-septate subhyaline and 26–60×4.5–7.2 μ in size.

15. *Cercospora Oenotherae* Ell. et Ev. in Proc. Acad. Phil. p. 380, 1894.—Sacc. Syll. Fung. XI, p. 625, 1895.

Hab. On *Oenothera biennis* L. (Tsukimi-sô).

Pref. Kagoshima: Oyama, July 28, 1924, T. Nojima.

This is also the first record of this fungus in Japan. The result of my study is as follows:—

Spots irregular or subcircular, greyish brown and 3–8 mm. in diameter; conidiophores amphigenous, 7–17 or more fasciculate, short, simple, subundulate, mostly continuous, but sometimes 1 or 2-septate, olivaceous or subhyaline and 16–32×2.7–3.6 μ conidia slender, elongate-obclavate, straight or slightly curved, 2–9-septate, subhyaline and 40–122×2.2–3.6 μ.

The size of the conidia of *Cercospora Oenotherae* Ell. et Ev. given by Saccardo (25–80×2.0–2.5 μ) differs a little from that of our fungus. Welles[1] has proved, however, that the spore dimensions of *Cercospora* alter considerably according to the environmental conditions. It is, therefore, reasonable to use the above name for our fungus.

The descriptions of *Cercospora didymospora* Ell. et Barth., *C. Oenotherae-sinuatae* Atk., *Cercosporella Oenotherae* Speg. all differ much from our fungus. In our country T. Fukui[2] reported the occurrence of *Cercospora Oenotherae-sinuatae* on *Oenothera biennis* which is a new host for this fungus, but our fungus apparently differs from *C. Oenotherae-sinuatae*.

16. *Ramularia Saxifragae* Syd. in Mycotheca Marchica n. 2596, 1889.—Sacc. Syll. Fung. XIV, p. 1061, 1899.—Lindau, Rabenh. Kr. Fl. VIII, p. 455, 1906.

---

1) Welles, C. G. in Science N. S. LIX, 1522, pp. 216–218, 1924.

2) Fukui, T. in Byochugai-zasshi (Journ. Plant Protection) V, p. 888, 1918.

Hab. On *Saxifraga cortusaefolia* Sieb. et Zucc. (Daimonji-sô).

Pref. Kyoto: Kurama, June 14, 1924, K. Togashi. Pref. Tottori: Taisenji, July 1, 1924, K. Togashi.

So far as the writer knows, the present fungus has not yet been reported in our country and *Saxifraga cortusaefolia* seems to be a new host for this fungus. The general characters of our fungus are as follows:—

Foliicolous, spots irregular, large, often limited by the veins, not bordered, coalescent, sometimes covering a greater part of the surface and brownish; conidiophores hypophyllous, rarely amphigenous, flocculent, powdery, white, short, simple, unseptate and generally 28–32 × 2.7–3.6 μ; conidia cylindrical, rounded at both ends, mostly continuous or 1-septate, but rarely 2-septate, hyaline and 15–31 × 3.5–7.2 μ.

We wish here to express our sincere thanks to Prof. Dr. G. Koidzumi and also to Mr. S. Miki for kindly identifying the host plants of our materials.

December 25, 1925.

Laboratory of Phytopathology,
Department of Agriculture,
Kyoto Imperial University,
Kyoto, Japan.

大正十五年五月二十五日印刷
大正十五年五月二十八日發行

編輯兼發行者　盛岡高等農林學校

印刷人　東京府荏原郡世田谷字下町五十番地　大久保秀次郎

印刷所　東京市京橋區築地二丁目十七番地　株式會社東京築地活版製造所

CONTENTS